REMARKS/ARGUMENTS

Claims 7-20 remain pending in the application, as claims 1-6 were previously canceled in view of a restriction requirement. In the Office Action, the drawings were objected to under 37 C.F.R. 1.83(a). Applicants have added a new drawing (FIG. 5) and accompanying text in the specification that overcomes the objection. Support for the new drawing and text can be found in paragraph 0006, paragraph 0013 and paragraph 0018. No new matter has been added. A more detailed discussion of this support will be presented below.

Also in the Office Action, claims 7-20 were rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. Claims 7, 8 and 15-20 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,346,118 to Degani, et al. (Degani). In addition, claims 7-9, 15-17 and 20 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,150,717 to Wood, et al. (Wood). Claims 7 and 20 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,539,153 to Schwiebert (Schwiebert). Finally, claims 11 and 13 were rejected under 35 U.S.C. 103(a) as being unpatentable over Schwiebert in view of Degani.

Concerning the 112 rejection, Applicants submit that there is ample support in the specification for the claim feature that both the solder of the first composition and the second composition are in a collapsed state. In particular, the purpose of section 112, first paragraph, is to ensure that there is an adequate disclosure of the invention for which patent rights are sought. Kennecott Corp. v. Kyocera Int'l., Inc., 835 F.2d 1419, 1421 (Fed. Cir. 1987). Generally, although the applicant does not have to describe exactly the subject matter claimed, the description must clearly allow persons of ordinary skill in the art to recognize that the applicant invented what is claimed. In re Daniels, 144 F.3d 1452, 1456 (Fed. Cir. 1998). Moreover, "[b]y disclosing . . . in a patent application a device that inherently performs a function, operates according to a theory, or has an advantage, a patent applicant necessarily discloses that function, theory, or advantage *even though he says nothing concerning it*. Id. at 1422 (emphasis added). The application may later be amended to recite the function, theory or advantage without introducing prohibited new matter. In re Smythe, 480 F.2d 1376, 1384 (CCPA 1973).

Here, it is clear that the original disclosure includes the teaching that both the solder of the first composition and the solder of the second composition are in a collapsed state, at least as understood by one of skill in the art. In paragraph 0006 of the present application, it is noted that "the method can include the step of reflowing the solder of the first composition and the solder of the second composition. Ideally, the bond formed between the first and second substrates is crack-free. The crack-free bond should be understood to mean that the solder and the substrates will be substantially free from cracks." Moreover, examples of the melting temperatures of the solder of the first composition and the second composition are provided in paragraph 0013, and it is noted that cracks in the solder and the substrates due to the reflow process will be reduced or completely eliminated. Finally, in paragraph 0018, it is explained that the solder of the first composition and the solder of the second composition can be reflowed and that these solders can be strategically positioned on the substrates to minimize cracking.

Those of skill in the art will realize that the reflow process will result in the melting of the solders of the two different compositions. In fact, examples of the melting temperatures of these solders are provided to demonstrate how the different solders can improve the structural integrity of the module. Moreover, this same skilled artisan would understand that the use of the term "crack-free bond," particularly when used in the context of solder, implies that the solder has been melted. As further evidence, one of skill in the art would understand that the issue of CTE mismatch becomes troublesome after solder has been melted to form a bond, and the invention expressly seeks to control stresses associated with the different substrates. As such, one of skill in the art would understand that the solders of different compositions in the final assembly would have melted to form bonds between the different substrates.

In view of the above, a skilled artisan would understand that following the reflow process, the solders of different compositions would have lost their structural rigidity. As a result, it is clear to one of skill in the art that the solder of the first composition and the solder of the second composition would be in a collapsed state following the reflow process. While not expressly stated in the specification, this limitation is clearly supported and taught in the specification in accordance with the principles of the Daniels and Smythe decisions set forth above. For this reason, Applicants request that the Examiner remove the 112 rejection.

Concerning the 102 and 103 rejections, a brief summary of the Wood, Degani and Schwiebert references may be helpful. Degani discloses a process for soldering a component having solder bumps to a substrate. In particular, in FIG. 4, Degani shows an assembly with solder bumps (12) on an IC package (10) and solder bumps (17) formed on a board (11). A similar construction is shown in FIG. 5 in which solder paste deposits (18) are formed over terminal pads (14) on the board (11). Degani does not describe the placement of solder of different compositions in different areas between the IC package (10) and the board (11) or solders of two different compositions being in a collapsed state. In addition, the process described in Degani addresses the issue of establishing a reliable solder joint while at the same time avoiding shorts between adjacent solder joints. Degani never discusses the issue of different coefficients of thermal expansion (CTE) between various substrates.

Wood is directed to a semiconductor package and a method for fabricating the package. As shown in FIGs. 11-11E, bumped electrodes (96) and solder bumps (12M) can be formed of various alloys. In particular, the solder bumps (12M) are formed of a high-temperature solder alloy, and the bumped electrodes (96) are comprised of a low-temperature solder alloy. The temperature of a reflow process is maintained at a temperature *between* the different melting temperatures of these solder alloys. As a result, the bumped electrodes (96) liquefy and form a bonded connection with the solder bumps (12M). The solder bumps (12M), however, maintain their structural rigidity during the reflow process, which prevents collapse of the die (10M) onto the supporting substrate. Moreover, Wood does not describe the placement of solder of different compositions in different areas between the die (10M) and the supporting substrate such that the different compositions are vertically separated. Wood also does not address the issue of mismatching CTEs; the process described above is only concerned with preventing a component from collapsing onto a board.

Schwiebert discloses a method of bumping substrates by contained paste deposition. As depicted in FIGs. 6A-6C, stand-off bumps (610) and metal bumps for interconnection (612) are formed on a substrate. The stand-off bumps (610) are made of a material that has a higher melting point than the metal bumps (612). As such, during reflow, the stand-off bumps (610) will not melt and collapse, i.e., they will maintain their structural rigidity, and the metal bumps for interconnection (612) will liquefy. The final product is shown in FIG. 6C. Here, the stand-off bumps (610) are provided merely to set and control the height between two substrates. Further, the metal bumps (612), which have a lower melting point than that of the stand-off bumps (610), are placed in the center of the substrate, and the stand-off bumps (610) are positioned at the periphery of the substrate (see FIGs. 6B and 6C).

Independent claim 7 recites the feature that the solder of the first composition and the solder of the second composition are vertically separated and that both are in a collapsed state. As explained above, support for the amendment can be found in FIG. 2 and in paragraph 0018 on page 6. Additionally, dependent claims 18 and 19 recite the feature that the solder of the first composition, which is in a substantially centrally-located area of the first substrate or the second substrate, has a higher melting point than the solder of the second composition, which is in a substantially peripherally-located area about the centrally-located area.

Neither Degani nor Wood show, teach, illustrate or even suggest solder of a first composition in a first area between the first substrate and the second substrate and solder of a second composition in a second area between the first and second substrates, which is separate from the first area. Moreover, these references do not show such different solders as being vertically separated. Indeed, such concepts do not apply to these two prior art references because neither is concerned with nor even mentions CTE mismatch between different substrates. Because CTE mismatch was addressed during its production, the final assembly in the present invention is more stable than prior art assemblies.

Also, Degani and Wood do not disclose, teach, illustrate or suggest the concept of having both the solder of the first composition and the solder of the second composition in a collapsed state. At best, Wood shows bumped electrodes in a collapsed state (see FIG. 11C), but the "solder bumps (12M) have a structural rigidity that prevents collapse of the die (10M) onto the supporting substrate." (see col. 10, lines 4-6). In addition, one of the solders in Schwiebert is a stand-off bump, which maintains its structural integrity throughout the reflow process and does not collapse. As a result, the stand-off bumps that reside between the two substrates are not in a collapsed state (see FIG. 6C).

In contrast with these prior art references, the different solders in the present invention are in a collapsed state in the final assembly. Because they were allowed to liquefy during the reflow process, the final assembly that includes the collapsed solders of the present invention will be lower in height than in Degani, Wood or Schwiebert, which is important in view of certain electronic devices becoming smaller and smaller. In addition, the collapsed solder of the present invention results in a final assembly that has a higher structural integrity than that in these prior art references.

In reference to claims 18 and 19, neither Degani, Wood nor Schwiebert disclose, teach, illustrate or suggest the concept of solder of a first composition, which is in a substantially centrally-located area of the first substrate or the second substrate, having a higher melting point than solder of a second composition, which is in a substantially peripherally-located area about the centrally-located area. Such a concept, as described in the present invention, allows for a more structurally sound assembly.

Applicants also submit that the feature that both the solder of the first composition and the solder of the second composition being in a collapsed state is a structural limitation. In particular, this state is present following the reflow of the solders of the first and second compositions. It is this end product that includes structural features that distinguish it from the prior art.

In view of the above, Applicants believe that independent claim 7 is patentable over the prior art. Applicants also believe that those claims that depend from these independent claims - particularly, dependent claims 18 and 19 - are now patentable, in view of both their dependence from these claims and their independent patentability. Reconsideration and withdrawal of the rejection of the claims is respectfully requested. Passing of this case is now believed to be in order, and a Notice of Allowance is earnestly solicited.

No amendment made was related to the statutory requirements of patentability unless expressly stated herein. No amendment made was for the purpose of narrowing the scope of any claim, unless Applicants have argued herein that such amendment was made to distinguish over a particular reference or combination of references.

In the event that the Examiner deems the present application non-allowable, it is requested that the Examiner telephone the Applicants' attorney or agent at the number indicated below so that the prosecution of the present case may be advanced by the clarification of any continuing rejection.

The Commissioner is hereby authorized to charge any necessary fee, or credit any overpayment, to Motorola, Inc. Deposit Account No. 50-2117.

Respectfully submitted,

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Amendments to the Drawings:

Please note that Applicants have added a new sheet of drawings that illustrates FIG. 5. The text accompanying the new drawings is included in this amendment.